appearing thereacross when they are de-energized. Condensers 213 and 214 associated with the motor energizing contacts are for the purpose of minimizing sparking at the contacts.

When the registration marks are light colored with respect to a darker background, then the abrupt reduction in the amount of reflected light which occurs after the mark has passed the scanner causes a negative pulse of voltage to be coupled through the condenser 183 to the amplifier control grid. That is, the control action is triggered by the contrast at the trailing edge of the mark instead of the leading edge of the mark. As explained further below, provision is made for shifting, or "zeroing" in the position of the cut-off with respect to the cut-off marks 16, so that it is immaterial whether the contrast at the leading or trailing edge of the registration marks produces the control action.

In view of the somewhat erratic but small dimensional changes which may occur in the corrugated board as it is being dried and cooled, it is usually found desirable to space the brushes 188 and 190 farther apart than the width of the insulating sector 189. In this way a certain desirable amount of latitude or "dead space" in the selector switch is obtained which allows for such minor deviations in the positions of the registration marks as results from dimensional changes during drying and cooling of the board. In many instances these dimensional changes tend to offset one another. Thus, the various helper marks may deviate slightly in position, and yet the cut-off is correctly positioned. Any consistent deviations which begin to accumulate are immediately sensed and automatically corrected. The dead space adjustment is obtained by changing the spacing of the two brushes. By moving them farther apart the amount of latitude or dead space is increased and by moving them closer together it is decreased.

It is usually desirable to operate with as much dead space as possible while still maintaining the variations in cut-off position within commercially acceptable tolerances. As shown, a manually rotatable knob 210 acting upon an arcuate rack adjusts the dead space by shifting the brush 190 with respect to the other brush.

In order to produce the desired adjustment or "zeroing" of the cut-off position with respect to the cut-off marks 16, both of the brushes are carried in insulated relationship on a rotatable mounting disk (not shown) so that they can be simultaneously moved concentrically about the axis of the contact 106. This maintains their spacing but shifts their orientation with respect to the axis of the rotatable contact and produces a corresponding shift in the orientation of the cut-off position with respect to the cut-off marks 16.

It is usually found most satisfactory to adjust the sensitivity controls 164 and 174 to the minimum amount of sensitivity which will allow proper response to the registration marks. In this way the circuit is prevented from accidentally responding to glue marks, dirt marks, or the like which may occasionally lie in the scanning path.

The purpose of the pairs of relay contacts 168 and 170 is to ground the brush leads 191 and 192 immediately after either of the gas tubes 157 or 161 has been triggered. In this way the control of the gas-tubes is made independent of motion of the rotatable contact subsequent to the firing of the gas-tube.

In order to control the length of time during which the Thyratrons remain in conduction after being fired, and thus, to control the number of revolutions of the motor 120 upon each energization, the time-delay control circuit including the triode 142 is utilized. As explained above this triode is normally in full conduction. Its grid is returned to ground through an adjustable resistor 212 having its movable contact connected to ground through a resistor 214. A capacitor 216 couples the grid to the cathode 218, which in turn is connected to the top of the common cathode resistor 158. Upon firing of either of the gas tubes 157 or 161, a relatively large current flows through this cathode resistor 158 thus applying a large positive voltage to the cathode 218. Initially, the grid of the triode also is driven positive because of the coupling capacitor 216, and thus the triode remains in full conduction. However, the capacitor 216 charges through the time-delay control circuit 212—214 so that the grid becomes progressively more negative with respect to the cathode 218 and cuts off the conduction in the triode 142. This allows the contacts 150 to open, removing anode voltage from the Thyratrons and thus stopping energization of the motor 120. By moving the adjustable contact downwardly along the resistor 212 the time-constant of the circuit is increased so as to provide for a longer delay before the control motor is de-energized. That is, more corrective action occurs upon energization of the motor, and vice versa.

In general it is desirable to adjust the time-delay control for the minimum amount of time-delay which can maintain the registration desired under the conditions of operation. The reason for this is the erratic nature of dimensional changes in corrugated board occurring during drying and cooling. If the time-delay is adjusted to a larger value than necessary, the motor 120 tends to "hunt" back and forth about the desired position of registry. That is, it continuously over-corrects and reverses back and forth, placing an undue strain upon the apparatus.

In order to enable the operator manually to control the advance and retard, a pair of thumb buttons are provided (not shown). One of these closes a pair of contacts in parallel with the contacts 167 and 168, respectively. The other closes a pair of contacts in parallel with the contacts 169' and 170, respectively. Also, for indicating to the operator when the advance or retard circuits are being actuated, suitable pilot lights may be arranged to flash whenever the relays 152 or 154 are energized.

When properly adjusted with a desirable time-delay setting and the proper amount of dead space in the selector switch the control action is smooth and accurate. Small and commercially unimportant dimensional variations are accepted without any needless actuation of the corrective action, but any tendency toward cumulative error is immediately sensed and prevented. The intermediate "helper" marks are advantageous in enabling the apparatus to sense any trend toward cumulative error and thus to correct the trend before the cut-off mark is reached.

From the foregoing it will be understood that the illustrative embodiment of the pre-printed corrugated board fabrication and cut-off control methods and apparatus of the present invention described above are well suited to provide the advantages set forth, and since many possible embodiments may be made of the various features of this invention and as the method and apparatus herein described may be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense and that in certain instances, some of the features of the invention may be used without a corresponding use of other features, all without departing from the scope of the invention.

What is claimed is:

1. The method of producing corrugated board having a pre-printed design on at least one liner thereof and being cut into lengths with the cut-off position properly registered with respect to the pre-printed design comprising the steps of printing a repetitive design on a continuous web of material adapted to form one of the liners of the corrugated board, each repetition of said pre-printed design including a plurality of evenly spaced register marks, applying said pre-printed liner to one side of a corrugating medium with the pre-printed design toward the outside surface and applying a continuous web of material to the other side of said corrugating medium to form the other liner of the corrugated board and applying glue material